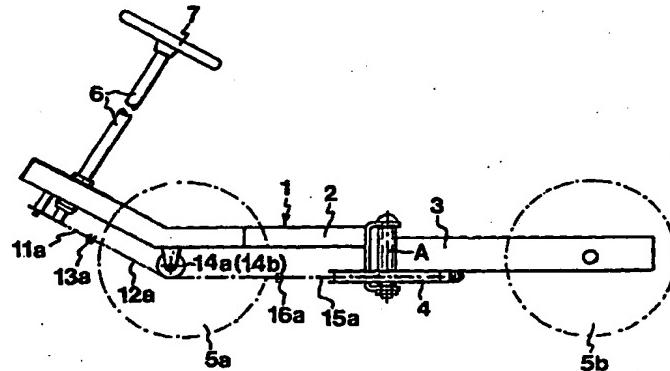


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(54) Title: STEERING DEVICE IN A RIDING MOWER AND LINK ELEMENTS INCLUDED THEREIN, FOR COUPLING TRANSMISSION CHAINS



## (57) Abstract

A device for steering a wheel assembly in a riding mower has a steering sprocket nonrotatably connected to a rotatable steering column and a transmission chain which is flexible in the plane of the steering sprocket and extends over the steering sprocket and forms, on both sides thereof, a rectilinear chain run. Two deflecting wheels arranged on both sides of the steering sprocket are positioned in a deflecting wheel plane turned around the respective chain run lines relative to the plane of the steering sprocket. Each of two transmission chains, which extend over the respective deflecting wheels between the free end of the respective chain runs and the wheel assembly, is, between the steering sprocket and the respective deflecting wheels, coupled by means of a link element (20) to the chain, which is flexible in the plane of the steering sprocket, so as to form a straight line with the chain, said link element having a first hinge pin (25) to which an end link (29) in one of the two coupled chains is articulated, and a second hinge pin (27) to which an end link (30) of the other of these two chains is articulated. The two hinge pins (25, 27) are turned relative to each other around the respective lines (L) at an angle equalling the angle at which the respective deflecting wheel plane is turned relative to the plane of the steering sprocket.

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WO 95/31891

PCT/SE95/00525

## 1

STEERING DEVICE IN A RIDING MOWER AND LINK ELEMENTS INCLUDED THEREIN, FOR COUPLING TRANSMISSION CHAINS

The present invention relates to a steering device in a riding mower having a wheel assembly which is pivotable by means of the steering device, said steering device comprising a rotatable steering column, a steering sprocket nonrotatably connected to the steering column, a transmission chain which is flexible in the plane of the steering sprocket and which extends over the steering sprocket and, on one side of the steering sprocket, forms a first chain run extending along a first straight line and, on the other side of the steering sprocket, forms a second chain run extending along a second straight line, two deflecting wheels which are arranged on both sides of the steering sprocket and located in a second and a third plane, respectively, which is turned around said first and said second straight line, respectively, relative to the plane of the steering sprocket, and two flexible steering wires which at one end are connected to the free end of the respective chain runs, extend over the respective deflecting wheels and at the other end are connected to the wheel assembly.

The invention also relates to a link element for coupling two transmission chains so as to form a straight line with each other, which is especially adapted to be used for coupling chains in a steering device of the type described above and which has a first pin which is perpendicular to said straight line and is arranged to form a hinge pin for an end link of one chain, and a second pin which is perpendicular to said straight line and is arranged to form a hinge pin for an end link of the other chain.

In a prior art steering device in a riding mower, use is made of a steering wire which is wound round a rotatable steering column and extends over two first deflecting wheels arranged on both sides of the steering

WO 95/31891

PCT/SE95/00525

2

column and located in a common plane, and two second deflecting wheels arranged on both sides of the steering column and located in a second and a third plane, respectively, which is substantially orthogonal relative to 5 this common plane, to a steerable wheel assembly, to which it is connected. This steering device suffers from the essential drawback that the steering wire is rapidly worn especially in the portion thereof extending over the steering column, but also in the portions extending over 10 the first and the second deflecting wheels. This results in frequent breaking of the steering wire, thus necessitating replacement.

In order to reduce this drawback, that part of the steering wire which extends over the steering column and 15 the two first deflecting wheels has been replaced in a known steering device, which is of the type described by way of introduction, with a transmission chain extending over a steering sprocket nonrotatably connected to the steering column and located in the same plane as the first 20 two deflecting wheels which here consist of sprockets. This chain is, at each end, connected to a steering wire which like before extends over the respective second deflecting wheels to the steerable wheel assembly. In this prior art steering device, the wear in the area of the 25 steering column is eliminated. The wear problem, however, remains for the steering wires which extend over the other two deflecting wheels and which therefore break relatively frequently.

One object of the present invention therefore is to 30 provide a steering device, in which also this wear problem is eliminated.

This object is achieved by means of a steering device which is of the type mentioned by way of introduction and characterised in that each of the flexible 35 steering wires consists of a transmission chain which is, between the steering sprocket and the respective deflecting wheels, coupled, by means of a link element, to the

WO 95/31891

PCT/SE95/00525

## 3

chain, flexible in the plane of the steering sprocket, so as to form a straight line with said chain, the link element having a first hinge pin to which an end link in one of these two chains is articulated, and a second hinge 5 pin to which an end link in the other of these two chains is articulated, said two hinge pins being turned around said first and said second straight line, respectively, relative to each other at an angle equalling the angle at which the second and the third plane, respectively, is 10 turned relative to the plane of the steering sprocket.

Both the second and the third plane are preferably turned 90° relative to the plane of the steering sprocket.

In a preferred embodiment of the inventive steering device, the two steering wires between the respective deflecting wheels and the wheel assembly are located in a common plane which is angled relative to the second and the third plane, the steering device comprising a steering pulley which is included in said wheel assembly and which is located in this common plane and to which the 15 steering wires are connected, and the steering device being characterised in that each of the chains forming the steering wires consists of two partial chains which between the respective deflecting wheels and the steering pulley are coupled together by means of a link element so 20 as to form a straight line with each other, the link element having a first hinge pin to which an end link of one partial chain is articulated, and a second hinge pin to which an end link of the other partial chain is articulated, said two hinge pins being turned around said 25 straight line relative to each other at an angle equaling the angle at which said common plane is angled relative to the second and the third plane, respectively.

A further object of the present invention is to provide a link element especially adapted for use in the inventive steering device, for easy coupling of two transmission chains to form a straight line with each other.

WO 95/31891

PCT/SE95/00525

4

This object is achieved by means of a link element which is of the type mentioned by way of introduction and characterised in that the two pins are turned relative to each other around said straight line.

5       The two pins are preferably turned 90° relative to each other.

The invention will now be described in more detail with reference to the accompanying drawings.

10      Fig. 1 is a schematic side view and illustrates a riding mower provided with a steering device according to the invention.

Figs 2-4 illustrate the riding mower from below, the steering device being shown in a starting position, a first end position and a second end position.

15      Fig. 5 is a perspective view of a first embodiment of an inventive link element.

Fig. 6 is a perspective view of a second embodiment of an inventive link element.

20      The riding mower 1 schematically shown in Fig. 1 is articulated and has a front frame 2 and a rear frame 3 which are pivotally connected to each other about a vertical pivot axis A. The front frame 2 supports the front wheels 5a of the riding mower. The rear frame 3 supports the rear wheels 5b of the riding mower 1 and is included 25 in a wheel assembly which is pivotable relative to the front frame 2. A steering pulley 4, which is fixedly connected to the rear frame 3 and whose centre axis coincides with the pivot axis A, is also included in the wheel assembly. The steering pulley 4 has two guiding 30 grooves (not shown) which are arranged in two diametrically opposed portions of the circumference of the pulley.

The steering device of the riding mower 1 has a steering column 6 which is rotatably mounted in the front 35 frame 2. The steering column 6 makes an angle of about 30° with the vertical plane and has, at its upper end, a steering wheel 7 for rotating the steering column 6. A

WO 95/31891

PCT/SE95/00525

## 5

steering sprocket 8 is nonrotatably connected to the steering column 6 at the lower end thereof. Four deflecting sprockets 9a, 9b, 10a and 10b are arranged in pairs on both sides of the steering sprocket 8 and located in 5 the same plane as this, i.e. in a plane which is inclined about 30° relative to the horizontal plane.

A roller chain 11, which is flexible in the plane of the sprockets, extends over the steering sprocket 8 and the deflecting sprockets 9a, 9b, 10a and 10b. The roller 10 chain 11 forms, on one side of the steering sprocket 8, a first chain run 11a, which extends rectilinearly backwards from the left-hand outer deflecting sprocket 10a, seen in the direction of forward travelling of the riding mower 1, and forms, on the other side of the steering 15 sprocket 8, a second chain run 11b, which extends rectilinearly backwards from the right-hand outer deflecting sprocket 10b.

The chain runs 11a and 11b are, at their free end, connected to one end of a roller chain 12a and 12b, respectively. Each chain run 11a and 11b and its roller 20 chain 12a and 12b are coupled together by means of a link element 13a and 13b, respectively, described in more detail below, in such a manner that in the coupling area they extend in a straight line with each other. The 25 roller chains 12a and 12b are flexible in the vertical direction and extend backwards over the respective deflecting sprockets 14a and 14b, in front of which they are, as appears from what has been said above, located in the above-mentioned plane inclined about 30°, and behind 30 which they are located in a common horizontal plane. The deflecting sprockets 14a and 14b have horizontal centre axes.

The roller chains 12a and 12b are, at their other end, connected to one end of a roller chain 15a and 15b, 35 respectively. The roller chains 12a and 15a as well as 12b and 15b are coupled together by means of a link element 16a and 16b, respectively, described in more detail

WO 95/31891

PCT/SE95/00525

## 6

below, in such a manner that that part of the roller chain 12a and 12b, respectively, which is positioned behind the respective deflecting sprockets 14a and 14b, and the roller chain 15a and 15b, respectively, extend in a straight line with each other. The roller chains 15a and 15b, which are thus located in said common horizontal plane, are flexible in the horizontal direction and each extend into one of the grooves at the circumference of the steering pulley 4. In a manner known for steering wires, the roller chains 15a and 15b are, at their rear end, connected to the steering pulley 4 via a spring mechanism 17a and 17b, respectively, the point of attachment 18b of the roller chain 15b being located closer to the centre of the steering pulley 4 than the point of attachment 18a of the roller chain 15a. The spring mechanisms 17a and 17b serve to prevent the steering wheel from stopping unresiliently when maximally turned in one or the other direction. The roller chain 15b extends to its point of attachment 18b via a sprocket 19 arranged on the underside of the steering pulley 4.

When turning the steering wheel 7 in one direction (clockwise as seen by the driver) from the starting position of the steering device, which is shown in Fig. 2 and in which the riding mower 1 is driven straight ahead, the wheel assembly 3, 4, 5b is pivoted in the direction of the end position shown in Fig. 3, whereby the riding mower 1 turns to the right, and when turning the steering wheel 7 in the opposite direction (anticlockwise as seen by the driver) from the starting position, the wheel assembly 3, 4, 5b is turned in the direction of the end position shown in Fig. 4, whereby the riding mower 1 turns to the left.

As appears from Figs 2-4, the two link elements 13a and 13b are, in each pivoting position of the wheel assembly 3, 4, 5b, positioned between the outer deflecting sprocket 10a and 10b, respectively, and the deflecting sprocket 14a and 14b, respectively, and the two link ele-

WO 95/31891

PCT/SE95/00525

7

ments 16a and 16b, respectively, are, in each pivoting position of the wheel assembly 3, 4, 5b, positioned between the deflecting sprocket 14a and 14b, respectively, and the steering pulley 4.

5 Fig. 5 illustrates a link element 20 according to the invention, which can be used for coupling the runs 11a and 11b of the roller chain 11 to the roller chain 12a and 12b, respectively, i.e. as link element 13a and 13b, respectively, and for coupling the roller chains 12a 10 and 12b to the roller chain 15a and 15b, respectively, i.e. as link element 16a and 16b, respectively.

The link element 20 is intended for coupling together two roller chains K1 and K2 in a straight line with each other. In Fig. 5, this line is designated L. 15 The link element 20 is substantially in the shape of a cube having a recess 21 on one side and a recess 22 on the opposite side. The recess 21 is defined by two parallel, vertical (as seen in Fig. 5) flanges 23, and the recess 22 is defined by two parallel, horizontal (as seen 20 in Fig. 5) flanges 24. The link element 20 is provided with a pin 25, which is insertable with a force fit into a hole 26 extending perpendicularly through the flanges 23 and intersecting the line L, and a pin 27, which is insertable with a force fit into a hole 28 extending perpendicularly through the flanges 24 and also intersecting the line L. When the pins 25 and 27 are inserted into the 25 hole 26 and 28, respectively, they are turned 90° relative to each other around the line L.

When coupling together two roller chains K1 and K2, 30 which should be bent in two planes perpendicular to one another, one proceeds as follows. An inner link 29 located at one end of one roller chain K1 is placed in the recess 21 in such a manner that its end sleeve is positioned just opposite the hole 26, whereupon the pin 25 is inserted 35 into the hole 26 so as to extend through the end sleeve and form a hinge pin for the inner link. An inner link 30 located at one end of the other roller chain K2 is then

WO 95/31891

PCT/SE95/00525

## 8

placed in the recess 22 in such a manner that its end sleeve is positioned just opposite the hole 28, whereupon the pin 27 is inserted into the hole 28 so as to extend through the end sleeve and form a hinge pin for the inner link.

5 The holes 26 and 28 and, thus, the pins 25 and 27 inserted therein need not be perpendicular to each other, but may be turned at an angle other than 90° relative to each other around the line L. The angle of turning is  
10 determined by and equals the angle between the planes in which the coupled roller chains K1 and K2 should be bent.

The link element can be designed in various ways within the scope of the invention. As shown in Fig. 6, it may be in the form of, for instance, a bar 20' without  
15 recesses, which in the same way as the link element 20 has two transverse through holes extending perpendicularly to each other, and is adapted to be placed between the end inner links 29 and 30 of two roller chains K1 and K2 that are turned 90° relative to each other, and to be  
20 connected to the inner links by means of two conventional chain locks 31 and 32, each having two parallel bolts 33, 34 and 35, 36, respectively. One bolt 33 of one chain lock 31 is inserted into the end sleeve of one inner link 29, and its other bolt 34 is inserted into one hole of  
25 the bar 20'. One bolt 35 of the other chain lock 32 is inserted into the end sleeve of the other inner link 30, and its other bolt 36 is inserted into the other hole of the bar 20'. Just like the holes 26 and 28 in the link element 20, the holes in the bar 20' need not be perpendicular to each other, but may be turned at an angle  
30 other than 90° relative to each other about the longitudinal axis of the bar.

Other transmission chains than roller chains, e.g. sleeve-type chains, can be used in the steering device  
35 according to the invention and be coupled together by means of link elements according to the invention.

WO 95/31891

PCT/SE95/00525

## CLAIMS

1. A steering device in a riding mower (1) having a  
5 wheel assembly (3, 4, 5b) which is pivotable by means of  
the steering device, said steering device comprising a  
rotatable steering column (6), a steering sprocket (8)  
nonrotatably connected to said steering column, a trans-  
mission chain (11) which is flexible in the plane of said  
10 steering sprocket and which extends over said steering  
sprocket (8) and, on one side of said steering sprocket,  
forms a first chain run (11a) extending along a first  
straight line and, on the other side of said steering  
sprocket, forms a second chain run (11b) extending along  
15 a second straight line, two deflecting wheels (14a, 14b)  
which are arranged on both sides of said steering  
sprocket (8) and located in a second and a third plane,  
respectively, which is turned around said first and said  
second straight line, respectively, relative to the plane  
20 of said steering sprocket, and two flexible steering  
wires (12a-15a, 12b-15b) which at one end are connected  
to the free end of the respective chain runs (11a, 11b),  
extend over the respective deflecting wheels (14a, 14b)  
and at the other end are connected to the wheel assembly  
25 (3, 4, 5b), characterised in that each of  
the flexible steering wires consists of a transmission  
chain (12a-15a, 12b-15b) which is, between the steering  
sprocket (8) and the respective deflecting wheels (14a,  
14b), coupled, by means of a link element (13a, 13b; 20;  
30 20'), to the chain (11), flexible in the plane of the  
steering sprocket, so as to form a straight line with  
said chain, said link element having a first hinge pin  
(25; 34) to which an end link in one of these two chains  
is articulated, and a second hinge pin (27; 36) to which  
35 an end link in the other of these two chains is articu-  
lated, said two hinge pins (25, 27; 34, 36) being turned  
around said first and said second straight line (L), re-

WO 95/31891

PCT/SE95/00525

10

spectively, relative to each other at an angle equalling the angle at which the second and the third plane, respectively, is turned relative to the plane of the steering sprocket.

5        2. The steering device as claimed in claim 1, characterised in that both the second and the third plane are turned 90° relative to the plane of the steering sprocket.

10      3. The steering device as claimed in claim 1 or 2, in which the two steering wires (12a-15a, 12b-15b) between the respective deflecting wheels (14a, 14b) and the wheel assembly (3, 4, 5b) are located in a common plane which is angled relative to the second and the third plane, the steering device comprising a steering pulley (4) which is included in said wheel assembly (3, 4, 5b) and which is located in this common plane and to which the steering wires are connected, characterised in that each of the chains (12a-15a, 12b-15b) forming the steering wires consists of two partial 15 chains (12a, 15a and 12b, 15b) which between the respective deflecting wheels (14a, 14b) and the steering pulley (4) are coupled together by means of a link element (16a, 16b; 20; 20'), so as to form a straight line with each other, said link element having a first hinge pin (25; 25) to which an end link of one partial chain (12a, 12b) is articulated, and a second hinge pin (27; 36) to which an end link of the other partial chain (15a, 15b) is articulated, said two hinge pins (25, 27; 34, 36) being turned around said straight line (L) relative to each 20 other at an angle equalling the angle at which said common plane is angled relative to the second and the third plane, respectively.

30      4. A link element for coupling two transmission chains (K1, K2) so as to form a straight line (L) with each other, which is especially adapted to be used for coupling chains in a steering device according to any one of the preceding claims and which has a first pin (25;

WO 95/31891

PCT/SE95/00525

11

34) which is perpendicular to said straight line (L) and is arranged to form a hinge pin for an end link (29) of one chain (K1), and a second pin (27; 36) which is perpendicular to said straight line (L) and is arranged to  
5 form a hinge pin for an end link (30) of the other chain (K2), characterised in that the two pins (25, 27; 34, 36) are turned relative to each other around said straight line (L).

5. The link element as claimed in claim 4, characterised in that the two pins (25, 27; 34, 36) are turned 90° relative to each other.

WO 95/31891

PCT/SE95/00525

1/3

FIG. I

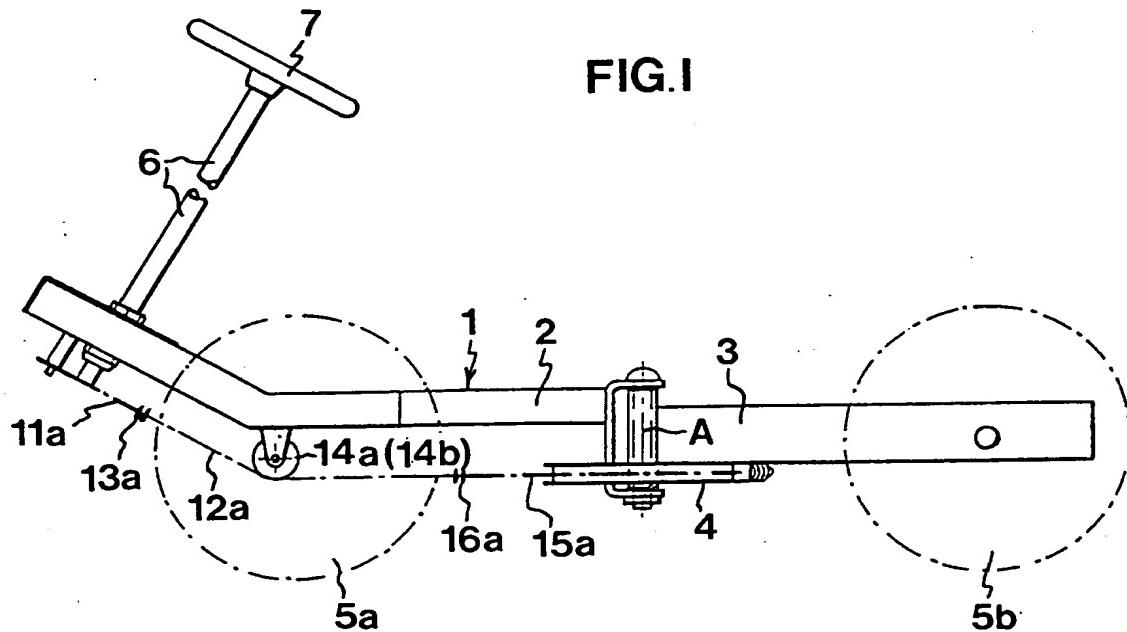
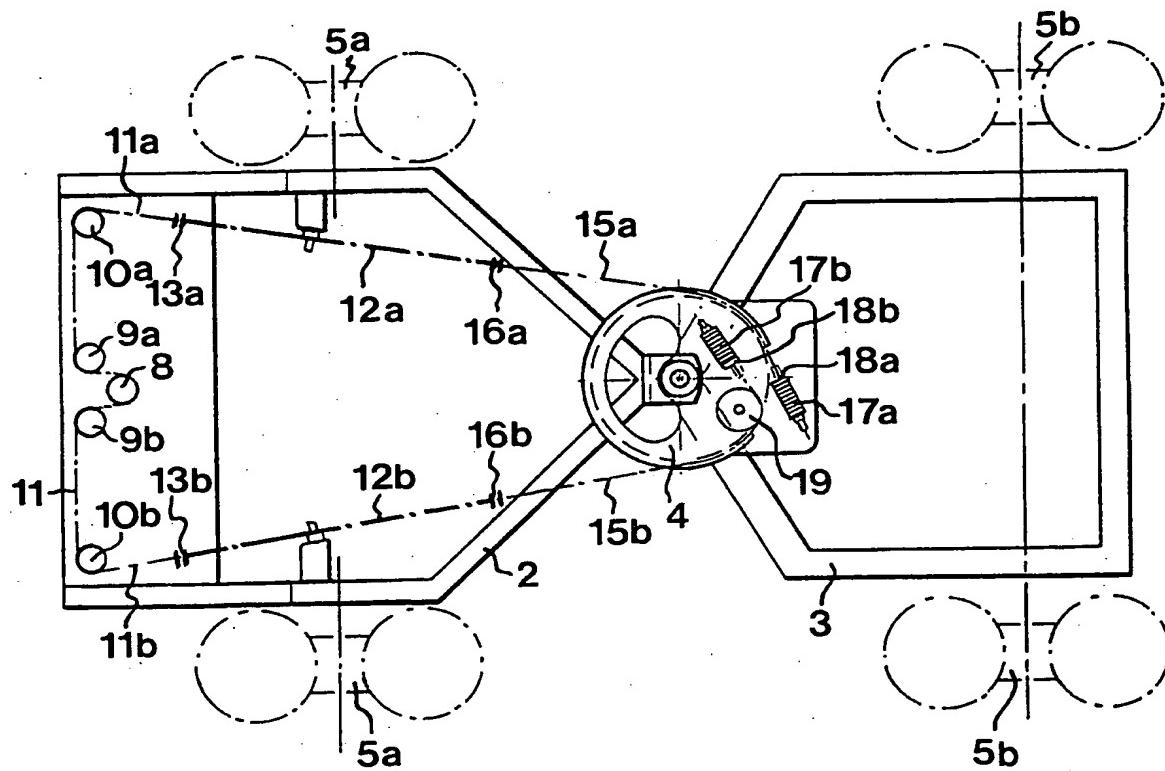


FIG. 2



WO 95/31891

PCT/SE95/00525

2/3

FIG. 4

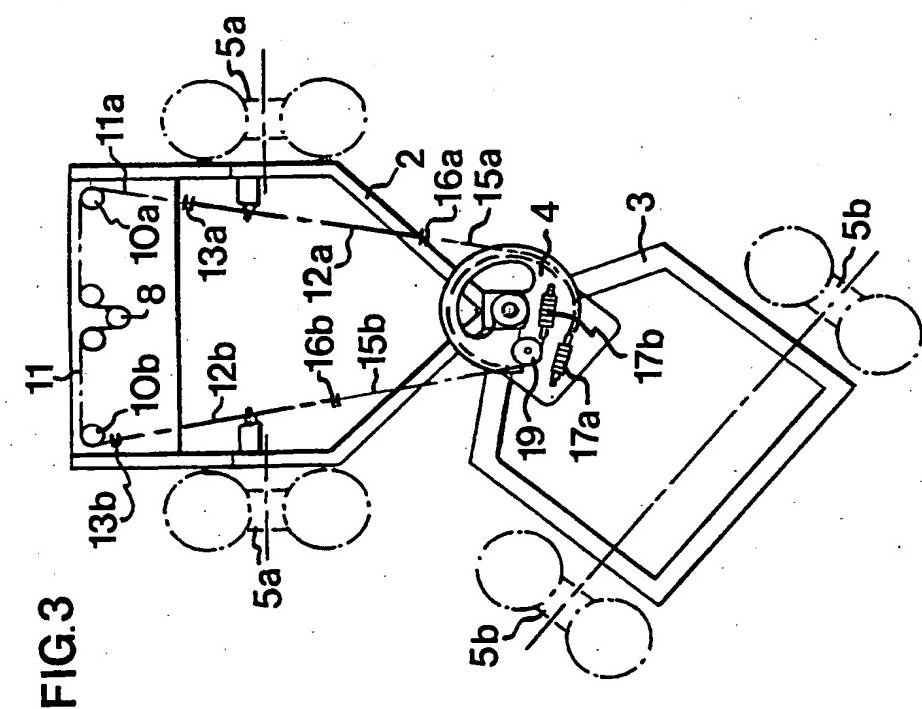
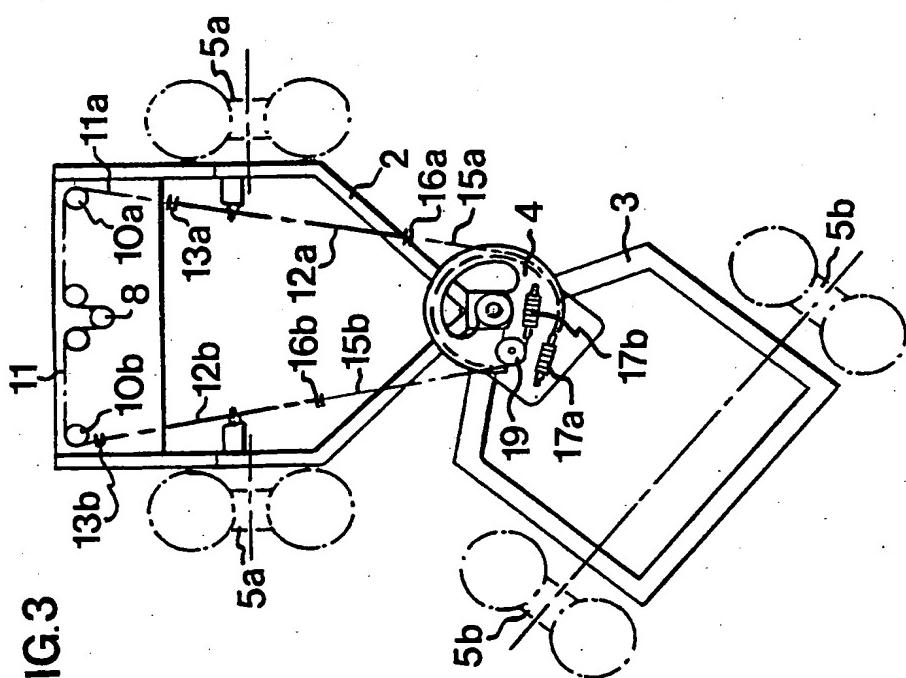


FIG. 3



WO 95/31891

PCT/SE95/00525

3/3

FIG.5

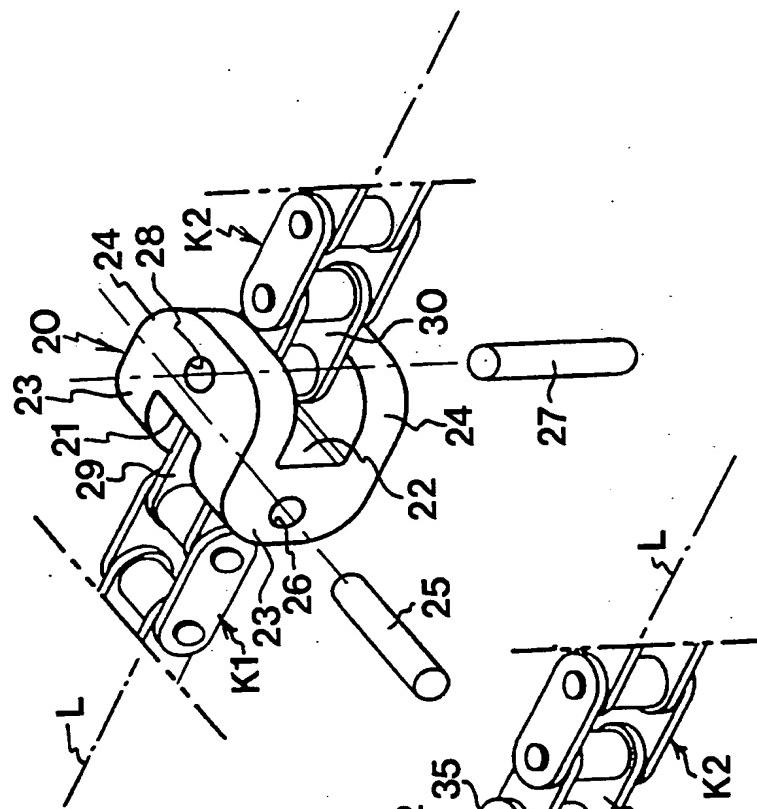
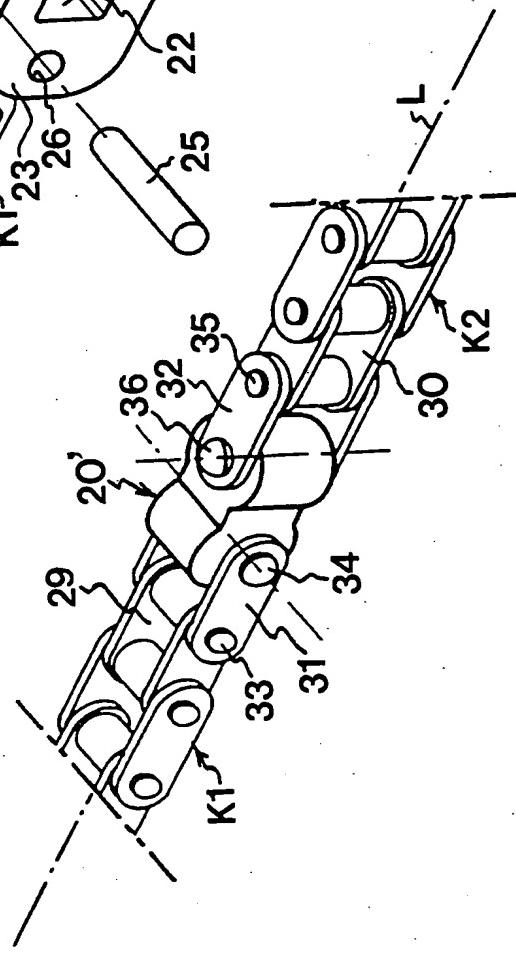


FIG.6



1

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 95/00525

## A. CLASSIFICATION OF SUBJECT MATTER

**IPC6:** A01D 34/64, B62D 12/00, B62D 7/00 // A01B 69/00  
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## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	SE 454127 B (HUSQVARNA AB), 11 April 1988 (11.04.88) --	1-3
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Date of the actual completion of the international search

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